USAARL Report No. 95-20

1

Evaluating the Potential for Rotation and Loss of Flight Helmets From Inertia and Impact Loads

(Reprint)

By

James E. Bruckart

and

Joseph L. Haley, Jr.

Aircrew Protection Division

March 1995

United States Army Aeromedical Research Laboratory
Fort Rucker, Alabama 36362-0577

Notice

Qualified requesters

Qualified requesters may obtain copies from the Defense Technical Information Center (DTIC), Cameron Station, Alexandria, Virginia 22314. Orders will be expedited if placed through the librarian or other person designated to request documents from DTIC.

Change of address

Organizations receiving reports from the U.S. Army Aeromedical Research Laboratory on automatic mailing lists should confirm correct address when corresponding about laboratory reports.

Disposition

Destroy this document when it is no longer needed. Do not return it to the originator.

Disclaimer

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other official documentation. Citation of trade names in this report does not constitute an official Department of the Army endorsement or approval of the use of such commercial items.

Reviewed:

Kevin T. Mason

KEVIN T. MASON
LTC, MC, MFS
Director, Aircrew Protection Division

ROGER W. WILEY, O.D., Ph.D.
Chairman, Scientific Review Committee

Released for publication:

Dennis F. Shanahan

DENNIS F. SHANAHAN
Colonel, MC, MFS
Commanding

Accesion For		
NTIS CRA&I		☑
DTIC TAB		☐
Unannounced		☐
Justification		
By		
Distribution /		
Availability Codes		
Dist	Avail and / or Special	
A-1		

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release, distribution unlimited
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) USAARL Report No. 95-20	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION U.S. Army Aeromedical Research Laboratory 6b. OFFICE SYMBOL (If applicable) MCMR-UAD	7a. NAME OF MONITORING ORGANIZATION U.S. Army Medical Research and Materiel Command
6c. ADDRESS (City, State, and ZIP Code) P.O. Box 620577 Fort Rucker, AL 36362-0577	7b. ADDRESS (City, State, and ZIP Code) Fort Detrick Frederick, MD 21702-5012
8a. NAME OF FUNDING / SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
62787A	30162787A878	EA	138

11. TITLE (Include Security Classification)
Evaluating the potential for rotation and loss of flight helmets from inertia and impact loads

12. PERSONAL AUTHOR(S)
James E. Bruckart, and Joseph L. Haley, Jr.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM TO	1995 March	5

16. SUPPLEMENTAL NOTATION
Reprint from Proceedings of the Thirty-First Annual Symposium, SAFE Association, November 8-10, 1993

17. COSATI CODES

FIELD	GROUP	SUB-GROUP
23	04	
20	11	

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
flight helmets, helicopter accidents, rotation, acceleration

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

In severe helicopter accidents, flight helmets rotate or sometimes come off the head, triggering wearer injury. This study evaluates rotation potential for new flight helmets. Current and prototype flight helmets (SPH-4B and two versions of the HGU-56) were subjected to three tests. First, rotation was measured with up to a 50-pound upward pull at the rear edge of the helmet on a medium-size headform. Second, angular displacement was measured with a 30-pound force at the side of the helmet. Third, the helmet was placed on a Hybrid II headform and Hybrid III neck, then mounted on a pendulum test device. The freefalling pendulum was decelerated to produce 16 to 20 G peak acceleration at the neck. Angular displacement of the helmet versus time was measured with high-speed video.

The upward pull tests produced 18 to 33 degrees of helmet rotation. Sideward loads produced 13 to 21 degrees of rotation. The pendulum test produced up to 45 degrees forward and up to 25 degrees rearward displacement.

(Continued on next page)

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Chief, Science Support Center	22b. TELEPHONE (Include Area Code) (334) 255-6907 22c. OFFICE SYMBOL MCMR-UAX-SI

19. Abstract (Continued):

The test series resulted in the selection of an improved HGU-56 design by the helmet developer. These tests may be improved by the use of more severe dynamic tests in the future to better reproduce severe impact conditions.

Evaluating the Potential For Rotation and Loss of Flight Helmets From Inertia and Impact Loads

James E. Bruckart, M.D.

Joseph L. Haley, Jr

U.S. Army Aeromedical Research Laboratory
Fort Rucker, AL 36362

ABSTRACT *In severe helicopter accidents, flight helmets rotate or sometimes come off the head, triggering wearer injury. This study evaluates rotation potential for new flight helmets. Current and prototype flight helmets (SPH-4B and two version of the HGU-56) were subjected to three tests. First, rotation was measured with up to a 50-pound upward pull at the rear edge of the helmet on a medium size headform. Second, angular displacement was measured with a 30 pound force at the side of the helmet. Third, the helmet was placed on a Hybrid II headform and Hybrid III neck, then mounted on a pendulum test device. The freefalling pendulum was decelerated to produce 16 to 20 G peak acceleration at the neck. Angular displacement of the helmet versus time was measured with high speed video.*

The upward pull tests produced 18 to 33 degrees of helmet rotation. Sideward loads produced 13 to 21 degrees of rotation. The pendulum test produced up to 45 degrees forward and up to 25 degrees rearward displacement.

The test series resulted in the selection of an improved HGU-56 design by the helmet developer. These tests may be improved by the use of more severe dynamic tests in the future to better reproduce severe impact conditions.

INTRODUCTION

Although flight helmets were scorned by some early safety authorities[1], Graeme Anderson reported in his 1919 aviation medicine text that of 58 training accidents in his experience, head protection saved student pilots from head injuries in 15.[2] Crowley studied survivable U.S. Army helicopter accidents from 1972-88 and found that the risk of fatal head injury was 6.3 times greater in unhelmeted occupants compared with those wearing the SPH-4 ($p<0.01$).[3]

The United States Army Aeromedical Research Laboratory (USAARL) evaluates aviation life support equipment (ALSE) retrieved from aircraft accidents. USAARL studies ALSE to correlate wearer injuries with the equipment performance. In 1984, Reading et al reported that 21 percent of the helmets in the USAARL database came off the wearer's head during the crash sequence. Chinstrap failure caused 63% of the helmet losses while failure or excessive stretching of the retention system accounted for the remainder.[4] In a later USAARL study by Vyrnwy-Jones et al, 18 of 60 flight helmets came off the wearer's head during the mishap. In this group of helmets, there were 11 chinstrap failures and 20 helmets with retention system damage. This study also found that the injuries were more severe for wearers that suffer excess rotation or loss of their flight helmet.[5]

These USAARL studies resulted in improvements to the retention system for Army flight helmets. The chinstrap of the original SPH-4 was upgraded in 1982 to include a dual-snap closure. The chinstrap was further improved when it was replaced with a stronger "yoke" chinstrap (440 lb vs 300 lb tensile strength and 1" vs 3" stretch) in the SPH-4B flight helmet. The strength of the chinstrap is tested by pulling the chinstrap with a prescribed load for 2 minutes and measuring the elongation. The chinstrap fails if there is excess elongation (typically > 1 to 1.5 inches) or it separates. In addition, the sling suspension assembly in the SPH-4 has been replaced with a thermoplastic liner in the SPH-4B.[6]

Despite these enhancements and standard qualification tests, flight helmets are still subject

to rotation and loss in aircraft mishaps. For example, in a recent mishap all twelve occupants of an MH-60, including the lone survivor, lost their helmet when the aircraft struck water. This occurred despite the fact that four aircraft occupants were wearing the newer SPH-4B helmets.

The purpose of this study was to investigate new tests to detect the design features of existing and prototype flight helmets that prevent rotation or loss in an aircraft accident. This data was needed to guide selection of an improved retention system for the new Aircrew Integrated Helmet System (AIHS), now designated the Head Gear Unit number 56 for Personnel (HGU-56/P).

MATERIALS AND METHODS

FLIGHT HELMETS

The SPH-4B and two different versions of the new HGU-56/P were selected for testing. The size regular SPH-4B flight helmet includes a thermoplastic liner, enhanced yoke assembly, and chinstrap secured with D-rings. The two HGU-56/P flight helmets included thermoplastic liners and chinstraps secured with D-rings.

The standard HGU-56/P includes a stiff plastic plate in the back of the helmet which forces the head forward when straps behind the plate are tightened. This "nape plate" rests on the back of the head, above the occipital ridge of the skull. The earcups are fixed to the outer shell with velcro (figure 1).

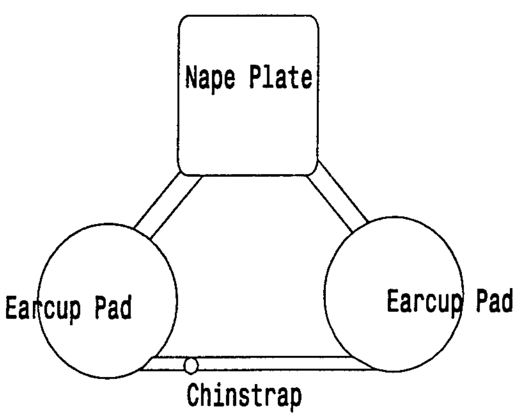

Figure 1. Nape plate and retention straps in original HGU-56/P flight helmet.

The revised HGU-56/P has a new retention system with a soft nape plate that form fits to the back of the skull, below the occipital ridge (figure 2). The velcro has been removed from the shell at the earcups and nylon straps run below the earcups to join the nape adjustment strap to the chinstrap. When the nape strap is tightened, the nape strap, side straps, and chinstrap form a ring around the base of the skull at the upper neck.

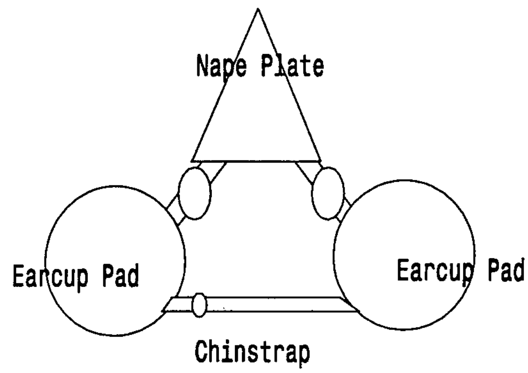

Figure 2. Nape strap and retention straps in improved HGU-56/P flight helmet.

ROTATION TESTS

Forward rotation of the helmet (about the lateral y-axis) in response to inertia was simulated by pulling upward on the rear edge of the helmet shell. The test helmet was placed on a 50th percentile military pilot headform rigidly mounted. A spring scale was used to pull on a small hook placed at the rear edge of the helmet shell. The forward rotation of the helmet was measured in response to pulling forces up to 50 pounds.

Sideward displacement of the helmet (about the vertical z-axis) in response to impact on the side of the helmet was simulated by pulling on the side of the helmet shell. The test helmet was mounted on the same 50th percentile headform. A spring scale was used to push at the edge of the helmet shell along the visor cover. The angular displacement of the helmet was measured in response to forces up to 30 pounds.

Dynamic testing of retention was performed by mounting each helmet on a Hybrid II headform, attached to a Hybrid III neck simulator, and placed at the end of a 6-foot pendulum arm (figure 3). The pendulum was allowed to freefall

through a vertical distance of 3.32 feet and was stopped by a foam block. The pendulum deceleration produced a 16 to 20 G deceleration force measured at the base of the neck simulator. High speed (1000 f/s) video frames were reviewed to measure the rotation of the helmet for each 10 ms time increment.

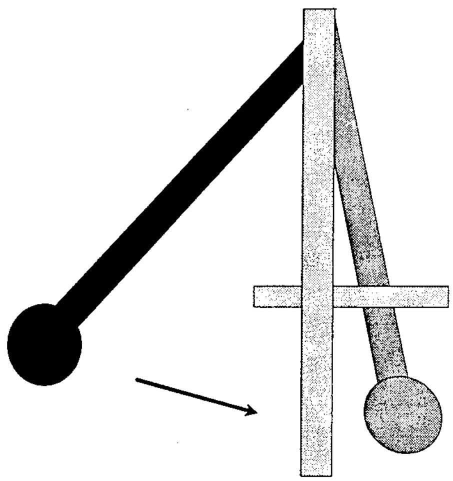

Figure 3. Schematic of pendulum test device.

RESULTS

The forward rotation of the helmets in response to a 50 pound force applied to the rear edge of the helmet shell varied from 18 to 33 degrees as shown in figure 4. The 30 pound force applied to the side of the visor resulted in 13 to 21 degrees of sideward rotation as shown in figure 5. The dynamic test produced forward and rearward rotation of the helmet as the neck flexed forward and back. The dynamic response of each helmet, measured by the rotation of the helmet relative to the headform, is shown in figure 6.

DISCUSSION

The most important factor in helmet retention is providing a chin strap and nape strap entity that will not stretch or tear in response to impact loads. USAARL has not seen a 440-pound tensile strength chin strap severed or separated in a survivable accident.

Compliant and stretchable materials are used to form the retention system and protective parts of most flight helmets. It is the stretching and compression of the retention system and internal foams that contributes to loss of helmets. For the

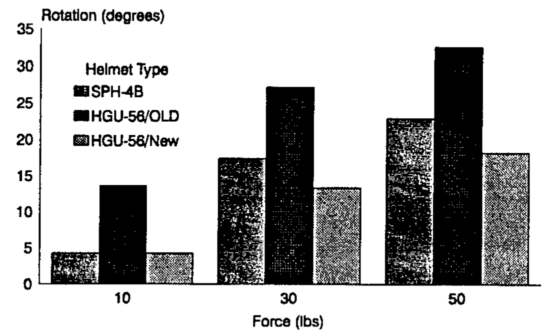

Figure 4. Forward rotation of helmets in response to force at rear edge of helmet.

helmet to dislodge from the head, there must be a large enough opening at the base of the helmet for the head to pass out of the helmet. The SPH-4B use a chin strap that is contiguous with material below the earcups and the nape strap to form a "ring" or "noose" around the neck. The circumference of this ring ultimately limits

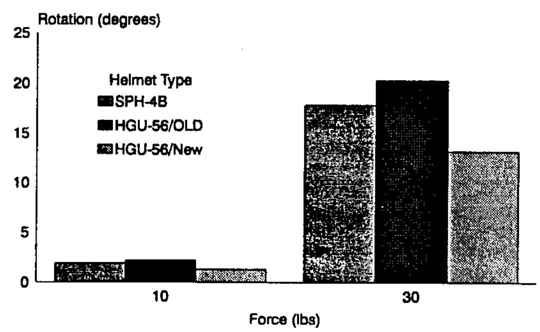

Figure 5. Sideward rotation of helmets in response to force at side of helmet visor.

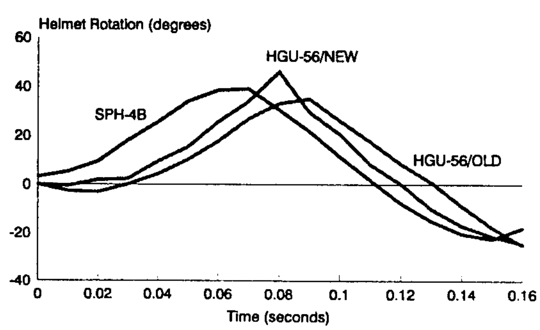

Figure 6. Forward and rearward rotation of the helmet on the head in response to dynamic impact simulation.

forward rotation and loss of the helmet. If the circumference of the "noose" is smaller than the circumference of the head, the helmet cannot rotate forward off the head. The original HGU-56/P configuration did not provide a separate nape strap or straps below the earcups. There was no ring of material around the neck to resist forward rotation. This resulted in the excess rotation and high potential for loss of this helmet. The new version of the HGU-56/P includes a separate nape strap that attaches to straps below each earcup. This forms a ring at the base of the neck and accounts for the superior performance of this design.

While the tests described in this paper assisted in evaluating the retention systems of these helmets, additional refinement of the test methods is required. We feel that greater loads should be placed on the back and sides of the helmet to better represent impacts in severe but survivable accidents. The torque applied in the horizontal plane to each helmet varies with the helmet diameter, but this variation simulates comparable torque applied to helmets with different diameters in actual crashes with tangential impacts.

CONCLUSIONS

The static and dynamic tests of the retention systems in Army flight helmets assisted in selection of an improved retention system for the HGU-56/P. Further refinement of retention tests may be needed to better simulate inertia and impact forces in survivable accidents.

REFERENCES

(1) Robinson, D. H., The Dangerous Sky: A History of Aviation Medicine. University of Washington Press, Seattle, 1973.

(2) Anderson, H. G., Medical and Survical Aspects of Aviation. Oxford University Press, London, p 192, 1919.

(3) Crowley, John S., "Should Helicopter Frequent Flyers Wear Head Protection? A Study of Helmet Effectiveness." Journal of Occupational Medicine, Volume 33, 1991.

(4) Reading, T. E., Haley, J. L., Jr., Sippo, A. C., Licina, J. R., and Schopper, A. W. SPH-4 US Army Flight Helmet Performance, 1972-1983. U.S. Army Aeromedical Research Laboratory. Fort Rucker, AL, USAARL Report 85-1, 1984.

(5) Vyrnwy-Jones, Peter, Lanoue, Bernard, and Pritts, Douglas, SPH-4 U.S. Army Flight Helmet Performance 1983-1987. U.S. Army Aeromedical Research Laboratory. Fort Rucker, AL, USAARL Report No. 88-15, 1988.

(6) Crowley, John S., Licina, Joesph R., and Bruckart, James E. "Flight Helmets: How They Work and Why You Should Wear One", Journal of Air Medical Transport, Vol 2, pp 19-26, 1992.

BIOGRAPHICAL SKETCHES

Major James E. Bruckart is a Senior Flight Surgeon in the Aircrew Protection Division of the U.S. Army Aeromedical Research Laboratory. He completed Bachelor and Master of Science degrees in Biomedical Engineering at Tulane University prior to entering medical school. He is board certified in Family Practice and Aerospace Medicine.

Mr. Joseph L. Haley Jr. is a safety engineer for Science Applications International Corporation. He has accumulated 31 years experience in crashworthiness research including 8 years with Aviation Safety Engineering and Research in Phoenix, AX and 23 years with the U.S. Army at Fort Rucker, AL. Mr. Haley is an original author of the Army's "Crash Survival Design Guide" and has authored over 30 publications on crashworthiness. He is the recipient of the Army's "Exceptional Civilian Service" award for his contributions to Army crash survival.

Initial distribution

Commander, U.S. Army Natick Research,
Development and Engineering Center
ATTN: SATNC-MIL (Documents
Librarian)
Natick, MA 01760-5040

Chairman
National Transportation Safety Board
800 Independence Avenue, S.W.
Washington, DC 20594

Commander
10th Medical Laboratory
ATTN: Audiologist
APO New York 09180

Naval Air Development Center
Technical Information Division
Technical Support Detachment
Warminster, PA 18974

Commanding Officer, Naval Medical
Research and Development Command
National Naval Medical Center
Bethesda, MD 20814-5044

Deputy Director, Defense Research
and Engineering
ATTN: Military Assistant
for Medical and Life Sciences
Washington, DC 20301-3080

Commander, U.S. Army Research
Institute of Environmental Medicine
Natick, MA 01760

Library
Naval Submarine Medical Research Lab
Box 900, Naval Sub Base
Groton, CT 06349-5900

Executive Director, U.S. Army Human
Research and Engineering Directorate
ATTN: Technical Library
Aberdeen Proving Ground, MD 21005

Commander
Man-Machine Integration System
Code 602
Naval Air Development Center
Warminster, PA 18974

Commander
Naval Air Development Center
ATTN: Code 602-B
Warminster, PA 18974

Commanding Officer
Armstrong Laboratory
Wright-Patterson
Air Force Base, OH 45433-6573

Director
Army Audiology and Speech Center
Walter Reed Army Medical Center
Washington, DC 20307-5001

Commander/Director
U.S. Army Combat Surveillance
and Target Acquisition Lab
ATTN: SFAE-IEW-JS
Fort Monmouth, NJ 07703-5305

Director
Federal Aviation Administration
FAA Technical Center
Atlantic City, NJ 08405

Director
Walter Reed Army Institute of Research
Washington, DC 20307-5100

Commander, U.S. Army Test
and Evaluation Command
Directorate for Test and Evaluation
ATTN: AMSTE-TA-M (Human Factors
Group)
Aberdeen Proving Ground,
MD 21005-5055

Naval Air Systems Command
Technical Air Library 950D
Room 278, Jefferson Plaza II
Department of the Navy
Washington, DC 20361

Director
U.S. Army Ballistic
Research Laboratory
ATTN: DRXBR-OD-ST Tech Reports
Aberdeen Proving Ground, MD 21005

Commander
U.S. Army Medical Research
Institute of Chemical Defense
ATTN: SGRD-UV-AO
Aberdeen Proving Ground,
MD 21010-5425

Commander
USAMRMC
ATTN: SGRD-RMS
Fort Detrick, Frederick, MD 21702-5012

HQ DA (DASG-PSP-O)
5109 Leesburg Pike
Falls Church, VA 22041-3258

Harry Diamond Laboratories
ATTN: Technical Information Branch
2800 Powder Mill Road
Adelphi, MD 20783-1197

U.S. Army Materiel Systems
Analysis Agency
ATTN: AMXSY-PA (Reports Processing)
Aberdeen Proving Ground
MD 21005-5071

U.S. Army Ordnance Center
and School Library
Simpson Hall, Building 3071
Aberdeen Proving Ground, MD 21005

U.S. Army Environmental
Hygiene Agency
ATTN: HSHB-MO-A
Aberdeen Proving Ground, MD 21010

Technical Library Chemical Research
and Development Center
Aberdeen Proving Ground, MD
21010-5423

Commander
U.S. Army Medical Research
Institute of Infectious Disease
ATTN: SGRD-UIZ-C
Fort Detrick, Frederick, MD 21702

Director, Biological
Sciences Division
Office of Naval Research
600 North Quincy Street
Arlington, VA 22217

Commandant
U.S. Army Aviation
Logistics School ATTN: ATSQ-TDN
Fort Eustis, VA 23604

Headquarters (ATMD)
U.S. Army Training
and Doctrine Command
ATTN: ATBO-M
Fort Monroe, VA 23651

IAF Liaison Officer for Safety
USAF Safety Agency/SEFF
9750 Avenue G, SE
Kirtland Air Force Base
NM 87117-5671

Naval Aerospace Medical
Institute Library
Building 1953, Code 03L
Pensacola, FL 32508-5600

Command Surgeon
HQ USCENTCOM (CCSG)
U.S. Central Command
MacDill Air Force Base, FL 33608

Director
Directorate of Combat Developments
ATTN: ATZQ-CD
Building 515
Fort Rucker, AL 36362

U.S. Air Force Institute
of Technology (AFIT/LDEE)
Building 640, Area B
Wright-Patterson
Air Force Base, OH 45433

Henry L. Taylor
Director, Institute of Aviation
University of Illinois-Willard Airport
Savoy, IL 61874

Chief, National Guard Bureau
ATTN: NGB-ARS
Arlington Hall Station
111 South George Mason Drive
Arlington, VA 22204-1382

AAMRL/HEX
Wright-Patterson
Air Force Base, OH 45433

Commander
U.S. Army Aviation and Troop Command
ATTN: AMSAT-R-ES
4300 Goodfellow Bouvelard
St. Louis, MO 63120-1798

U.S. Army Aviation and Troop Command
Library and Information Center Branch
ATTN: AMSAV-DIL
4300 Goodfellow Boulevard
St. Louis, MO 63120

Federal Aviation Administration
Civil Aeromedical Institute
Library AAM-400A
P.O. Box 25082
Oklahoma City, OK 73125

Commander
U.S. Army Medical Department
and School
ATTN: Library
Fort Sam Houston, TX 78234

Commander
U.S. Army Institute of Surgical Research
ATTN: SGRD-USM
Fort Sam Houston, TX 78234-6200

Air University Library
(AUL/LSE)
Maxwell Air Force Base, AL 36112

Product Manager
Aviation Life Support Equipment
ATTN: SFAE-AV-LSE
4300 Goodfellow Boulevard
St. Louis, MO 63120-1798

Commander and Director
USAE Waterways Experiment Station
ATTN: CEWES-IM-MI-R,
CD Department
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Commanding Officer
Naval Biodynamics Laboratory
P.O. Box 24907
New Orleans, LA 70189-0407

Assistant Commandant
U.S. Army Field Artillery School
ATTN: Morris Swott Technical Library
Fort Sill, OK 73503-0312

Mr. Peter Seib
Human Engineering Crew Station
Box 266
Westland Helicopters Limited
Yeovil, Somerset BA20 2YB UK

U.S. Army Dugway Proving Ground
Technical Library, Building 5330
Dugway, UT 84022

U.S. Army Yuma Proving Ground
Technical Library
Yuma, AZ 85364

AFFTC Technical Library
6510 TW/TSTL
Edwards Air Force Base,
CA 93523-5000

Commander
Code 3431
Naval Weapons Center
China Lake, CA 93555

Aeromechanics Laboratory
U.S. Army Research and Technical Labs
Ames Research Center, M/S 215-1
Moffett Field, CA 94035

Sixth U.S. Army
ATTN: SMA
Presidio of San Francisco, CA 94129

Commander
U.S. Army Aeromedical Center
Fort Rucker, AL 36362

Strughold Aeromedical Library
Document Service Section
2511 Kennedy Circle
Brooks Air Force Base, TX 78235-5122

Dr. Diane Damos
Department of Human Factors
ISSM, USC
Los Angeles, CA 90089-0021

U.S. Army White Sands
Missile Range
ATTN: STEWS-IM-ST
White Sands Missile Range, NM 88002

Director, Airworthiness Qualification Test
Directorate (ATTC)
ATTN: STEAT-AQ-O-TR (Tech Lib)
75 North Flightline Road
Edwards Air Force Base, CA 93523-6100

Ms. Sandra G. Hart
Ames Research Center
MS 262-3
Moffett Field, CA 94035

Commander
USAMRMC
ATTN: SGRD-UMZ
Fort Detrick, Frederick, MD 21702-5009

Commander
U.S. Army Health Services Command
ATTN: HSOP-SO
Fort Sam Houston, TX 78234-6000

U. S. Army Research Institute
Aviation R&D Activity
ATTN: PERI-IR
Fort Rucker, AL 36362

Commander
U.S. Army Safety Center
Fort Rucker, AL 36362

U.S. Army Aircraft Development
Test Activity
ATTN: STEBG-MP-P
Cairns Army Air Field
Fort Rucker, AL 36362

Commander
USAMRMC
ATTN: SGRD-PLC (COL R. Gifford)
Fort Detrick, Frederick, MD 21702

TRADOC Aviation LO
Unit 21551, Box A-209-A
APO AE 09777

Netherlands Army Liaison Office
Building 602
Fort Rucker, AL 36362

British Army Liaison Office
Building 602
Fort Rucker, AL 36362

Italian Army Liaison Office
Building 602
Fort Rucker, AL 36362

Directorate of Training Development
Building 502
Fort Rucker, AL 36362

Chief
USAHEL/USAAVNC Field Office
P. O. Box 716
Fort Rucker, AL 36362-5349

Commander, U.S. Army Aviation Center
and Fort Rucker
ATTN: ATZQ-CG
Fort Rucker, AL 36362

Dr. Sehchang Hah
Dept. of Behavior Sciences and
Leadership, Building 601, Room 281
U. S. Military Academy
West Point, NY 10996-1784

Canadian Army Liaison Office
Building 602
Fort Rucker, AL 36362

German Army Liaison Office
Building 602
Fort Rucker, AL 36362

French Army Liaison Office
USAAVNC (Building 602)
Fort Rucker, AL 36362-5021

Australian Army Liaison Office
Building 602
Fort Rucker, AL 36362

Dr. Garrison Rapmund
6 Burning Tree Court
Bethesda, MD 20817

Commandant, Royal Air Force
Institute of Aviation Medicine
Farnborough, Hampshire GU14 6SZ UK

Defense Technical Information
Cameron Station, Building 5
Alexandra, VA 22304-6145

Commander, U.S. Army Foreign Science
and Technology Center
AIFRTA (Davis)
220 7th Street, NE
Charlottesville, VA 22901-5396

Commander
Applied Technology Laboratory
USARTL-ATCOM
ATTN: Library, Building 401
Fort Eustis, VA 23604

Commander, U.S. Air Force
Development Test Center
101 West D Avenue, Suite 117
Eglin Air Force Base, FL 32542-5495

Aviation Medicine Clinic
TMC #22, SAAF
Fort Bragg, NC 28305

Dr. H. Dix Christensen
Bio-Medical Science Building, Room 753
Post Office Box 26901
Oklahoma City, OK 73190

Commander, U.S. Army Missile
Command
Redstone Scientific Information Center
ATTN: AMSMI-RD-CS-R
/ILL Documents
Redstone Arsenal, AL 35898

Aerospace Medicine Team
HQ ACC/SGST3
162 Dodd Boulevard, Suite 100
Langley Air Force Base,
VA 23665-1995

U.S. Army Research and Technology
Laboratories (AVSCOM)
Propulsion Laboratory MS 302-2
NASA Lewis Research Center
Cleveland, OH 44135

Commander
USAMRMC
ATTN: SGRD-ZC (COL John F. Glenn)
Fort Detrick, Frederick, MD 21702-5012

Dr. Eugene S. Channing
166 Baughman's Lane
Frederick, MD 21702-4083

U.S. Army Medical Department
and School
USAMRDALC Liaison
ATTN: HSMC-FR
Fort Sam Houston, TX 78234

NVESD
AMSEL-RD-NV-ASID-PST
(Attn: Trang Bui)
10221 Burbeck Road
Fort Belvior, VA 22060-5806

CA Av Med
HQ DAAC
Middle Wallop
Stockbridge, Hants S020 8DY UK

Dr. Christine Schlichting
Behavioral Sciences Department
Box 900, NAVUBASE NLON
Groton, CT 06349-5900

Commander
Aviation Applied Technology Directorate
ATTN: AMSAT-R-TV
Fort Eustis, VA 23604-5577

COL Yehezkel G. Caine, MD
Surgeon General, Israel Air Force
Aeromedical Center Library
P. O. Box 02166 I.D.F.
Israel

HQ ACC/DOHP
205 Dodd Boulevard, Suite 101
Langley Air Force Base,
VA 23665-2789

41st Rescue Squadron
41st RQS/SG
940 Range Road
Patrick Air Force Base,
FL 32925-5001

48th Rescue Squadron
48th RQS/SG
801 Dezonia Road
Holloman Air Force Base,
NM 88330-7715

HQ, AFOMA
ATTN: SGPA (Aerospace Medicine)
Bolling Air Force Base,
Washington, DC 20332-6128

ARNG Readiness Center
ATTN: NGB-AVN-OP
Arlington Hall Station
111 South George Mason Drive
Arlington, VA 22204-1382

35th Fighter Wing
35th FW/SG
PSC 1013
APO AE 09725-2055

66th Rescue Squadron
66th RQS/SG
4345 Tyndall Avenue
Nellis Air Force Base, NV 89191-6076

71st Rescue Squadron
71st RQS/SG
1139 Redstone Road
Patrick Air Force Base,
FL 32925-5000

Director
Aviation Research, Development
and Engineering Center
ATTN: AMSAT-R-Z
4300 Goodfellow Boulevard
St. Louis, MO 63120-1798

Commander
USAMRMC
ATTN: SGRD-ZB (COL C. Fred Tyner)
Fort Detrick, Frederick, MD 21702-5012

Commandant
U.S. Army Command and General Staff
College
ATTN: ATZL-SWS-L
Fort Levenworth, KS 66027-6900

Director
Army Personnel Research Establishment
Farnborough, Hants GU14 6SZ UK

Dr. A. Kornfield
895 Head Street
San Francisco, CA 94132-2813

Mr. George T. Singley, III
Depupty Assistant Secretary of the Army
for Research and Technology
and Chief Scientist
ATTN: Room 3E374
103 Army Pentagon
Washington, DC 20310-0103

The Honorable Gilbert F. Decker
Assistant Secretary of the Army
for Research, Development,
and Acquisition
ATTN: Room 2E672
103 Army Pentagon
Washington, DC 20310-0103

Dr. Craig Dorman
Office of the Deputy Director,
Defense Research and Engineering
ATTN: Room 3D129LM
103 Army Pentagon
Washington, DC 20310-0103

HQ, AFOMA
ATTN; SGPA (Aerospace Medicine)
Bolling Air Force Base,
Washington, DC 20332-6188

Cdr, PERSCOM
ATTN: TAPC-PLA
200 Stovall Street, Rm 3N25
Alexandria, VA 22332-0413